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Exploration Concepts for Syntectonic Sediments of Triassic and Jurassic Age along Northern and Eastern Rim of Gulf of Mexico Basin

Current tectonic models for the formation of the Gulf of Mexico generally include continental rifting starting in the Triassic and continuing through the Jurassic. A comparison between the sedimentology and structural geology of known continental rifts (such as the Gulf of Suez, Egypt) and the Triassic and Jurassic of the Gulf of Mexico suggests the following. (1) The interior salt basins of Texas, Louisiana, Mississippi, and Alabama probably were deposited within a failed continental rift. (2) Positive features such as the Angelina-Caldwell flexure, Wiggins arch, and Middle Ground arch probably represent the southern edge of the failed rift. (3) Positive features such as the Sabine uplift and Monroe arch are probably isolated horst blocks within the failed rift.

Pre-evaporite sediments account for much of the production in the Gulf of Suez, and these rock sequences are well exposed there on shore. Depositional and structural histories for these rocks are similar in both the Gulf of Mexico and Gulf of Suez, and a careful comparison suggests new play concepts for the Gulf of Mexico. The post-evaporite sequences of the Gulf of Suez are also similar to the Norphlet and Smackover Formations of the Gulf of Mexico, although Smackover equivalents are currently being deposited in the Gulf of Suez. Comparisons between the two rift systems indicate that a clearer understanding of the structural setting of the Gulf of Mexico at the time of deposition of the Norphlet and Smackover should lead to better exploration plays for these syntectonic formations.

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Barrier-Bar System in Cerro Negro, Orinoco Petroliferous Belt, Venezuela, and Its Implication in Oil Exploration and Exploitation

Barrier bars are important stratigraphic traps for oil and/or gas because of deposition in relatively shallow and often agitated waters, which allow barriers to develop excellent primary porosity and high permeability. Barrier bars can be developed as component facies of other depositional systems such as deltas or as independent interdeltaic systems associated with a major delta. In each case, different facies relationships such as distributary channel, mouth-bar, distal-bar, and prodelta facies would be present in a deltaic setting. Barrier bars, lagoons, washover-fans, and nonmarine facies could occur in an independent interdeltaic system. Different sand geometry patterns and reservoir characteristics are found in each system. In the Cerro Negro area, the sedimentary parameters are composite sand bodies, *Ophiomorpha*-type burrows, bioturbation structures, shell fragments, and an interfingering of brackish and shallow-marine fauna. Seven continuously cored wells and more than 100 geophysical well logs were used to determine lithofacies associations and to construct computer-drawn maps. These data were used to propose and support an independent interdeltaic barrier-bar system as the depositional model for the Cerro Negro area. Barriers were found to be mainly parallel to a paleoshoreline, and to have porosity values greater than 20% and permeability values greater than 500 md. It is interesting to note that different rates of heavy oil production can be related to the facies present.

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Dolomitization of Fossiliferous Siliciclastic Sediments in Salisbury Embayment

Bioclastic, medium-grained sand beds in the Chesapeake Group formations (Miocene) of Maryland and Virginia, contain abundant intergranular dolomite and calcite cement. The sand beds are dominated by fairly well-sorted subrounded quartz grains (mean grain size approximately 250 μm), molluscan-shell debris, and variable amounts of mud and iron oxides that coat many of the grains. The surfaces of the quartz grains surrounded by carbonate cement are etched and pitted, indicating high pH conditions within the diagenetic environment. Initially abundant primary porosity and permeability may be completely filled with diagenetic equant calcite spar and/or rhombic dolomite. However, shell material may be completely dissolved by this process, creating a conspicuous secondary porosity.

Dolomitization appears to be stratigraphically controlled by impermeable silty clay layers, above and below the sandy beds, which confine the diagenetic fluids to these zones. Though calcitization appears to be more variable, it also seems to be stratigraphically controlled.

Preliminary ^{13}C and ^{18}O results indicate that the dolomite and calcite cements are in isotopic equilibrium, and a ^{14}C-age determination suggests that dolomitization began less than 30,000 yr ago. The abundant presence of limpid dolomite suggests a fresh or brackish water origin for these cements, and the presence of ferroan dolomite may indicate an organic influence in the dolomitization process.

The confinement of diagenetic fluids in thin (1-2 m) permeable sand layers may induce the concentration of the necessary available cations to initiate dolomitization.

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Early-Diagenetic Sheet-Crack Cements of Guadalupian Shelf, Yates and Tansill Formations, New Mexico—a Field and Chemical Study

Tepee-associated sheet-crack structures and carbonate cements that largely fill them are developed in the carbonate facies of the back-reef Capitan Reef complex, Guadalupe Mountains, New Mexico. Sheet cracks, their cements, and associated teepee structures were studied to better understand the timing, nature of precipitating waters, and environment of deposition of the sheet-crack cements. Sheet-crack cements were field classified into 8 morphologic fabrics.

Contrary to previous work, this study found that sheet-crack fillings developed symmetrically from roofs and floors. Sheet-crack cements, the sheet cracks, and associated teepee structures developed repeatedly and episodically. Most are erosionally truncated and cross-cut by overlying surfaces. Most cements show isopachous growth indicative of precipitation under phreatic conditions. Some pendant cements suggest precipitation in a vadose environment, indicating occasional exposure of the outer-shelf and shelf-crest facies.

Calcite-cement fabrics (39 samples) were analyzed for Sr, Mg, Fe, $\delta^{13}C$, and $\delta^{18}O$. Chemical compositions range from: Sr = 116 to 5,244 ppm; Mg = 215 to 9,188 ppm; Fe = 7 to 758 ppm; $\delta^{18}O = -5.6$ to $+0.4$ ‰; and $\delta^{13}C = +4.9$ to 7.5 ‰ (PDB). Sr exhibits distinct groupings of more than 2,000 ppm and fewer than 500 ppm. Samples with high Sr are associated with lower $\delta^{13}C$, $\delta^{18}O$, and Mg compositions. The converse is true for the low Sr values.

Isotopically heavier samples are interpreted as precipitated from restricted marine waters. Isotopically lighter samples are interpreted as precipitated from mixed meteoric and marine waters. The meteoric water is inferred to have originated from shelfward, terrestrial source areas. It is hypothesized that these waters traveled through an aquifer system and percolated upward as springs to the sheet-crack area.

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Cyrenaican Platform: Structure, Stratigraphy, and Exploration Play Concepts

The structural and stratigraphic history of the Cyrenaican platform of eastern Libya is closely related to that of both the Sirte basin and the Western Desert of Egypt. At the end of the Paleozoic Hercynian orogeny, this area comprised the eastern end of the Sirte arch, the precursor of the Sirte basin. When the arch collapsed in the mid-Cretaceous, initiating the Sirte basin, the Cyrenaican area remained relatively high. A northwest-southeast trending high, the Gabboub arch, formed on the platform in the early Mesozoic, dividing the region into three areas: the high itself, a deep on the southwestern flank related to the Sirte basin, and a deep on the northeastern flank, which plunges into the offshore and appears to relate to the downwarped offshore area of the Western Desert of Egypt.

Sediments of every age, except Triassic, are found in Cyrenaica. Paleozoic sediments are composed primarily of quartzitic sandstones and shales with lesser amounts of limestone, dolomites, and anhydrites.